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Original Research Article

To Determine the Incidence of Acute Renal Failure in a Cohort of Patients with Risk, Injury, and Failure Factors Admitted to the Surgical Intensive Care Unit

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Abstract

Background: Critically sick patients who experience acute renal failure (ARF) have a higher fatality risk. Our understanding of the disease has improved as a result of several pathophysiologic pathways linked to ARF. Changes in glomerular filtration, tubular dysfunction, and changes in renal perfusion can all lead to ARF. ARF's effects can be changed by early intervention and adjustment of these conditions. Renal replacement therapy (RRT) is one of the new therapeutic therapies that has been established that has the ability to alter the course of ARF in critically ill patients. Over the previous three decades, patient survival has not significantly increased despite advancements in intensive care and dialysis technology.

Aim: To ascertain the prevalence of acute renal failure in a group of patients admitted to the surgical intensive care unit of the hospital who also had risk, injury, and failure factors. To evaluate patient mortality after developing acute renal failure.

Material and Method: The study was a uni-center prospective cohort study with an observational design, conducted in the Department of Anesthesiology. 500 patients were admitted to the surgical intensive care unit during the research period. 60 of these patients had acute renal failure according to the RIFLE criteria. The distribution of the 60 patients with ARF throughout the age deciles followed a normal distribution, with the majority of the patients lying in the 30 to 70 age range. All patients >14 years old admitted to the surgical intensive care unit who met any one of the inclusion criteria for acute renal failure were included in this study.

Results: Sepsis was the main contributor of ARF in the research population. Sepsis was determined to be present in 35 of the 60 individuals. Polytrauma (10%) was the second most typical cause of ARF. 10% of patients had ARF as the cause of post-arrest sequelae. ARF was brought on by hemorrhagic shock in 4% of patients and hepatorenal syndrome in 6% of patients, respectively. All three groups' mean values were discovered to be lower for the risk group and higher for the injury and failure groups after that. When these prognostic scores were applied to the survivors and non-survivors, we discovered statistical significance between them for the APACHE and sofa scores. The analysis of variance for these components was statistically significant.

Conclusion: The clinical profiles and outcomes of patients classified as risk, injury, or failure using the rifle grading for ARF are identified and described in this study. We discovered that 22% of patients admitted to the surgical ICU over time had ARF as part of

their clinical profile. Those with ARF had a mortality rate of 47%. Mortality was associated with higher APACHE II scores, extended breathing, lower mean arterial pressures at admission, lower arterial pH, poorer urine output, and higher random blood sugar levels on admission. The aforementioned findings demonstrate that the RIFLE grading was very precise in terms of identifying sicker patients within the study sample.

Keywords: Acute Renal Failure, Renal Replacement Therapy, Acute Tubular Necrosis And Sequential Organ Failure Assessment.

Introduction

Depending on the population being examined and the criteria used to identify its existence, the clinical condition known as Acute Renal Failure (ARF) is said to occur in 1% to 25% of severely ill individuals. [1,2] A common clinical occurrence, acute renal failure is characterized by a sudden loss of the kidneys' capacity to excrete wastes, concentrate urine, conserve electrolytes, and maintain fluid balance. It is particularly common in the intensive care unit, where it is linked to a mortality rate of 50% to 80%. [3-4] During the World War II bombing of London, Bywaters and Beall described an immediate loss of kidney function that happened in critically injured crash victims. This clinical condition was referred to as acute tubular necrosis (ATN). 10% of all patients admitted to the intensive care unit (ICU) may develop ARF as a result of ATN, which is linked to significant morbidity and mortality. [5]

Amphotericin B, an antifungal drug, significantly damages kidney function. ARF (defined as either a doubling of serum creatinine or a level greater than 3 mg/dl) occurred in only 12% of patients treated with liposomal amphotericin B compared to 26% of patients in the conventional group in a randomized trial of liposomal amphotericin B versus conventional amphotericin B in patients with sustained neutropenic fever. [6] Patients with traumatic rhabdomyolysis should receive rapid and aggressive volume resuscitation since their need for crystalloid may be relatively high. Animal studies back their use, and in the absence of complicating conditions like severe hypokalemia and hypocalcemia, the risk of treatment with these medicines in this situation is low even though the efficacy of bicarbonate and mannitol administration is yet unknown. [7]

Many of the patients admitted to the intensive care unit appear to have multi-organ failure as a result of the usual inflammatory response being dysregulated in acute renal failure. When compared to healthy people or people with end-stage renal failure, patients with ARF have higher levels of pro-inflammatory mediators like tumor necrosis factor and interleukin 1 beta, 6 and 8. Interleukin 10 levels are also up, indicating an inflammatory immune response. Interstitial edema results from the dysregulation of the salt and water channels after reperfusion of the kidneys following ischemia, as well as from increased vascular permeability in the lungs. [8]

It has been noted that the long-term survival of patients who have recovered from critical illness is significantly more encouraging than the in-hospital survival statistics given by most research. It has been estimated that up to 30% of individuals who have endured an episode of renal failure will require post-recovery renal replacement therapy. One study found that patients who survived hospital

discharge had a 6-month survival rate of about 69% and a 5-year survival rate of about 50%. [9] In the aforementioned study, 77% of the patients reported good to excellent health. 73% of subjects survived for six months, according to another prospective study. [10] Health-related quality of life (HRQL) may not be anticipated from data available at the time of dialysis beginning in the aforementioned study, according to literature on quality of life after therapy for ARF. It is unlikely that we will ever have an epidemiologic surveillance system for ARF that is equivalent to those offered for other infectious or multisystem illnesses. ARF can be defined as the emergence of a rapid and sustained decline in GFR, urine output, an increase in serum creatinine from the baseline values, and/or all three parameters. The current understanding of the epidemiology of ARF, as per the studies that are currently available, adds to the mounting evidence that Acute Renal Failure is a significant public health burden, taking its toll in morbidity, mortality, and cost, and justifies the call for additional research support in order to ultimately provide more effective preventive and therapeutic interventions.

Material and Methods

The study was a uni-center prospective cohort study with an observational design, conducted in the department of Anesthesiology. 500 patients were admitted to the surgical intensive care unit during the research period. 60 of these patients had acute renal failure according to the RIFLE criteria. The distribution of the 60 patients with ARF throughout the age deciles followed a normal distribution, with the majority of the patients lying in the 30 to 70 age range.

Study population

All patients >14 years old admitted to the surgical intensive care unit who met any one of the inclusion criteria for acute renal failure were included in this study. The RIFLE criteria for diagnosing renal failure served as the study's inclusion criterion. [11]

Patients were excluded from the study if

- ✓ Age was under 14 years old.
- ✓ RIFLE defines loss or end-stage renal disease.

Sample size:

Before the study began, a specific time period was selected on the statistician's recommendation. Six months was chosen as the duration. All patients hospitalized to this tertiary referral hospital's surgical intensive care unit would be screened using the RIFLE criteria before being added to the trial. The study included both patients who met the criteria for admission and those who developed acute renal failure while receiving care in the surgical ICU for other conditions. The first day of the trial was the day that participants were admitted. Based on the RIFLE criteria's serum creatinine or urine output components, all patients were included in the study. The streamlined Modification of diet in renal disease (MDRD) method was used to predict the baseline creatinine levels for patients with no prior records and no history of preexisting renal disease.

Data collection

At the time of admission, the Sequential Organ Failure Assessment (SOFA) score and the Acute Physiology and Chronic Health Evaluation II (APACHE II) score were calculated to determine the severity of the disease (Appendix 2,4,5and 6). Additionally, daily measurements for urine production, the greatest levels of lactate, and arbitrary blood sugar levels were collected. For the purposes of this investigation, the treatment alternatives were not randomized. According to the ICU protocol in place, all management choices were made. The decision to use RRT was made after discussion with our group of nephrologists. At the time of enrollment in the trial, patients with ARF

were screened to determine their diagnosis. The diagnosis that was presumed to be causing acute renal failure was taken into account as the etiology if the patient's diagnosis changed while they were in the surgical intensive care unit.

Statistical analysis

It was conducted using SPSS 11.5 (Statistical package for social sciences Inc. Chicago, IL). Continuous data were analyzed using the T-test and are shown as mean and (standard deviations). For comparing numerical values between groups, the analysis of variance test was used, and the chi-square test was used to compare proportions. The tests mentioned above were used to analyze mortality-related factors. A logistic regression analysis using mortality as the dependent variable was then performed on the relevant factors that had been discovered.

Result: -

In this study, the risk category included 45% of the ARF patients, the injury category included 33% of the patients, and the failure category included 22% of the patients.

Table 1: Etiology of Acute Renal Failure and outcome.

Etiology	Frequency	Percent	Mortality	Case fatality
Sepsis	35	56.7	12/35	62%
Polytrauma	6	10.3	1/6	10%
Crush syndrome	3	4.1	2/3	75%
Hepato renal syndrome	3	6.2	1/3	33%
Acute cardio-respiratory failure	5	11	3/5	50%
Major surgery	3	6.2	0/3	0%
Obstructive renal failure	1	1.0	0/1	0%
Renal parenchymal causes	1	1 1.0	0/1	0%
Hemorrhagic shock	3	4.1	1/3	25%

Sepsis was the main contributor of ARF in the research population. Sepsis was determined to be present in 35 of the 60 individuals. Polytrauma (10%) was the second most typical cause of ARF. 10% of patients had ARF as the cause of post-arrest sequelae. ARF was brought on by hemorrhagic shock in 4% of patients and hepatorenal syndrome in 6% of patients, respectively. The mortality rate was 47% for the 60 patients who were admitted with ARF. Sepsis was the major cause of death. Sepsis had a 62% case fatality rate. In our study, sepsis and ARF together are linked to increased mortality. It was discovered that sepsis was a substantial cause of death.

Table 2: Prognostic screening for patients based on the outcome

Outcome.		Age	ICU days	Mech. ventilation days	APACHE II APACHE	APACHE expected mortality (%)	APACHE adjusted mortality n	SOFA admission
Survivors	Mean SD	40.53 (13.22)	2.38 (2.22)	2.72 (2.17)	13.51 (2.883)	12.62 (11.101)	23.18 (14.856)	3.323 (2.02)
Non-Survivors	Mean SD	42.13 (12.39)	3.44 (2.84.	3.16 (2.55)	12.32 (3.261)	40.32 (12.143)	52.27 (12.266)	8.2 (1.77)

The SOFA score and APACHE II results demonstrated a distinct separation between the three groups. All three groups' mean values were discovered to be lower for the

risk group and higher for the injury and failure groups after that. When these prognostic scores were applied to the survivors and non-survivors, we discovered statistical significance between them for the APACHE and SOFA scores. The analysis of variance for these components was statistically significant.

Discussion

ARF prevalence reported in the critically ill population ranges from 3% to 25%. 2,6,22,115. Mendonca et al.2 reported the highest prevalence of ARF (24%) in the severely ill, with renal failure brought on by surgical or trauma-related illness accounting for one-fourth of the cases. The prevalence was determined to be 22% in our study, which was restricted to the surgical intensive care unit. According to prospective studies using the RIFLE criteria, 52% of patients had ARF. The percentages of patients in the risk, damage, and failure groups were 49%, 29%, and 22%, respectively. 32%, 30.6%, and 23%, according to Ahlstrom et al. [12] and Obaseif et al. [13] 22% incidence is revealed by our study conducted in the SICU. The percentage of patients who fell into the risk, injury, and failure categories for the group was 47%, 31%, and 22%, respectively.

Increasing age was found to be strongly linked with mortality in patients with ARF, according to studies by Uchino et al. [14] and Mendonca et al.2 Age, the prevalence of ARF, and mortality were not significantly correlated in our study. This may be due to the fact that the majority of the patients admitted for this study were between the ages of 30 and 65, and the numbers over 65 were not statistically significant enough to be compared. Similar results from other studies have been found, too. [15,16,17]

Mendonca et al.2 utilized the SOFA score, and Obaseif et al. [13] used the SAPS II score, and both groups discovered a significant correlation between higher admission scores and mortality. In their prospective study, Flavio et al. [18] demonstrated that initial SOFA scores of 11 or above were suggestive of a death prediction of 80%. Illness was identified as the sepsis that caused ARF most frequently in this sample of patients. Acute renal failure with an emphasis on sepsis was the subject of numerous research. According to Hoste et al. [15], 16.2% of patients with sepsis had an incidence of ARF. Both Rangel et al. [19] and Brun et al. [20] showed a 19% and 21% incidence, respectively. Schrier et al. [21] discovered that septic shock and sepsis with a positive culture raised the incidence of ARF to 23% and 51%, respectively. ARF aggravating sepsis has a mortality rate of between 50 and 70 percent.

According to Arabi et al. [22], 44% of severely ill cirrhotic patients had an incidence of ARF. None of the study participants who experienced hepatorenal syndrome (HRS) were believed to have cirrhosis. Four individuals experienced liver failure brought on by cholecystitis or cancer, while two patients had jaundice that complicated pregnancy. Since the trial was conducted in a surgical ICU, HRS after cirrhosis might not have been evident.

According to Mattana et al. [23], ARF in patients who have experienced cardiorespiratory arrest has been linked to a high death rate of 93%. In our study, this subgroup's death rate was 50%. In our analysis, major surgery accounted for 6% of the causes of ARF, obstructive renal failure 1%, intrinsic reasons 1%, and hemorrhagic shock 4%. These did not significantly affect mortality.

Renal replacement therapy has been around for a while, but many patients have underlying illnesses that put them at risk for both acute renal failure and the accompanying extrarenal problems that lead to multiorgan failure. There is disagreement on the ideal dose for patients with ARF, despite the fact that there is

general agreement that the necessity for RRT and the amount of hemodialysis administered are associated to morbidity and mortality. Regarding the aforementioned, conflicting statistics are available. [24] Since it is based on sparse and contradictory information, the notion that increasing the use of RRT and intensifying the hemodialysis dose administered to critically sick patients with acute renal failure lowers the rate of uremic complications and improves outcomes is rational but remains unproven.

Diuretic usage was substantially related with unfavorable outcomes in ARF, according to a logistic regression study. This could be caused by a delayed implementation of RRT or a direct harmful effect of diuretic drugs, as suggested by Pascual and Mehta [25] and Lamiere et al. [26] There are currently no data from randomized, blinded clinical trials available. To demonstrate its value in ARF, more studies are required. Logistic regression was used to assess the factors that contributed to the outcome in terms of mortality. The risk, injury, and failure groups had significantly different physiological and biochemical markers from the first day, and these differences were predictive of mortality after ARF. When compared to Hoste et al. [15] and Abosaif et al. [13], these findings are comparable. [27] We discovered through logistic regression that high random blood sugar levels upon admission were linked to a higher fatality rate. [28]

Conclusion

The clinical profiles and outcomes of patients classified as Risk, Injury, or Failure using the RIFLE grading for ARF are identified and described in this study. We discovered that 22% of patients admitted to the surgical ICU over time had ARF as part of their clinical profile. Those with ARF had a mortality rate of 47%. Mortality was associated with higher APACHE II scores, extended breathing, lower mean arterial pressures at admission, lower arterial pH, poorer urine output, and higher random blood sugar levels on admission. The aforementioned findings demonstrate that the RIFLE grading was very precise in terms of identifying sicker patients within the study sample.

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